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ORIGINAL MEMOIRS.

A CASE OF MALIGNANT ŒDEMA.

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THE bacillus of malignant œdema (Koch) or the vibron septique (Pasteur) has been thoroughly studied experimentally. This bacillus is common in garden earth, from which it is easily obtained by animal inoculation. The clinical picture of this infection in the human being is not often recognized, owing to its confusion with infection by the bacillus *aerogenes capsulatus* of Welch. For this reason, it is of importance to record a case of emphysematous gangrene known not to be caused by Welch's bacillus. Cases of malignant œdema have been occasionally reported, but only a few with sufficient bacteriological proof that they are due to infection with the bacillus of malignant œdema rather than with other bacteria. The writer has not been able to find an authentic case in English literature, and only five cases in the literature of the world.

The five cases in which the infecting bacillus seems to have been proven to be the bacillus of malignant œdema are as follows:

1. Giglio describes a case of an abscess in the pouch of Douglas. Cultures and animal experiments showed the presence of the malignant œdema bacillus in the pus.

2. Menereul's case was an insane woman who drank some infected fluid. This was followed by intestinal symptoms and by gaseous gangrene of the inside of the left thigh. Cultures taken at the autopsy showed malignant *œdema bacilli* in the blood and organs. Animal experiments were positive.

3 and 4. Hämig and Silbersehnidt report two cases. The first was a compound fracture of the left forearm, said to have been carefully cleaned with an antiseptic at the time of the injury. The patient died of sepsis. Two organisms were found in this case,—the bacillus of malignant *œdema* and the bacillus coli communis. This is rather a doubtful case, since the liver and other organs contained more gas than is caused by malignant *œdema* alone. It is possible that a combination of the two organisms might cause this condition. The second case was a compound fracture of the elbow and wrist-joints. In this case the streptococcus pyogenes and the bacillus of malignant *œdema* were found. In both of these cases cultures were positive.

5. Witte. A case of pyosalpinx with bloody gaseous exudate. Malignant *œdema bacilli* were demonstrated in the left oviduct by animal experiments and cultures.

Besides the above five cases, three more cases may be mentioned, because they are commonly cited as true cases of malignant *œdema*; but the writer feels that their bacteriological proof is insufficient.

1. Braatz describes an abscess of the neck in which bacilli resembling malignant *œdema bacilli* were found under the microscope. No cultures are mentioned.

2 and 3. Briger and Ehrlich describe two cases of typhoid fever, in both of which gaseous gangrene supervened after the subcutaneous injection of musk. The identity of the organism was not proved by cultures in either case.

The following case entered the service of Dr. J. Collins Warren, at the Massachusetts General Hospital, November 27, 1902. The patient was an Italian laborer, forty-nine years of age, who, six days before his entrance, had been caught between

an elevator and a wall. A lacerated wound of the right heel was sustained which required two stitches. Two days later the patient came under the care of Dr. Homan, who found the wound septic. The edges of the wound were gangrenous and somewhat swollen with gas. The wound was cleaned with peroxide of hydrogen and poulticed. Twenty-four hours before his admission to the hospital, the swelling extended around the ankle and had commenced to spread up the leg. Upon reaching the hospital, an examination showed the posterior aspect of the right heel to be covered by an irregular black eschar, occupying an area three inches long by two inches wide. In the middle of the diseased area was found a lacerated opening through which exuded foul-smelling, bloody pus. No redness or œdema were present below the ankle-joint or on the dorsum of the foot. Above the ankle for six to eight inches, along the back of the leg, redness, induration, and œdema were noted, while crepitation could be plainly felt about the ankle itself. The glands in Scarpa's triangle and in the groin were enlarged, but were not tender. Temperature, 102° F.; pulse, 100; respiration, 25; white count, 13,000; urine, normal. The man refused operation, and during the night the emphysema extended up the leg to within two inches of the tuberosity of the tibia, in front, and to within three inches of the popliteal space, behind. The posterior aspect of the leg was black and mottled, while the anterior aspect was covered with yellow and blue streaks. The œdema extended over the ankle and the dorsum of the foot. The temperature in the morning was 99° F.; pulse, 80. The man finally consented to an operation, and an amputation at the knee-joint was accordingly done by Dr. Warren. The temperature remained elevated to 100° or 101° for six days; afterwards it subsided to normal. The wound healed well with the exception of the anterior flap, in which a small portion of the discolored tissue had been included. After the separation of the slough, no further trouble occurred. Twenty-four days after the operation, the patient underwent a mild attack of pneumonia, the temperature again reaching normal on the thirty-fifth day. The patient was discharged well.

Bacteriological Examination.—Cultures made from the diseased tissue of the amputated leg showed the presence of an obligate anaërobic spore-bearing bacillus, in addition to other

bacteria. It will be seen from the description of this bacillus, given below, that it corresponds, in morphological and cultural peculiarities, and in pathogenic effect upon guinea-pigs, with the bacillus of malignant œdema. The bacillus *aerogenes capsulatus* of Welch was sought for, but was not found.

The bacteriological study of this case was made under the supervision of Dr. J. H. Wright, Director of the Clinico-Pathological Laboratory of the Massachusetts General Hospital.

Description of the Bacillus.—This bacillus is about 0.75 micron thick, and has square or rounded ends. It occurs singly, in chains and in long filaments, and is provided with numerous flagella which project from its ends and sides (Fig. 2).

The bacillus forms oval spores, which appear usually in the middle, though occasionally towards one end of the rod. The spores are thicker than the body of the bacillus (Fig. 1). The spore formation is best seen in gelatin and in bouillon cultures.

The behavior of the bacillus towards Gram's stain is not constant. In cultures, some of the bacteria partially decolorize, others completely, others not at all. In the animal recently dead of infection with the bacillus, none of the bacteria in the peritoneal exudate decolorize. It would seem that this inconstant behavior towards the Gram stain is dependent upon degeneration of the organism.

The bacillus is motile. The motility is not demonstrable in the bacilli from cultures, but is easily made out in the blood and in the peritoneal exudate of animals dead of infection with the bacillus. The motility persists for some hours.

The bacillus is an obligate anaërobe, and grows on most of the usual culture media, both in the incubator and at room temperature. It ferments glucose with the production of gas. The growth in various media is best at reactions varying from 0 to + 1. (Scale of the American Public Health Association.)

Cultures and animals dead of infection with the bacillus have a peculiar putrefactive odor.

Cultures.—In 1 per cent. glucose agar suspension culture, after twenty-four hours, colonies appear in the lower three-quarters of the medium, consisting of indefinite fuzzy masses which may attain a diameter of two or three millimetres. No growth ever occurs in the superficial layers of the tube (Fig. 5).

Under the microscope, the colonies appear to be made up of

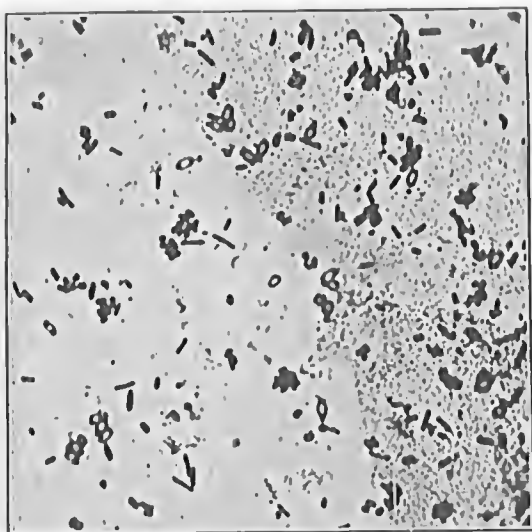


FIG. 1.—Spore formation. $\times 1500$.



FIG. 2.—Long and short forms. Variation to the Gram stain. $\times 1500$.

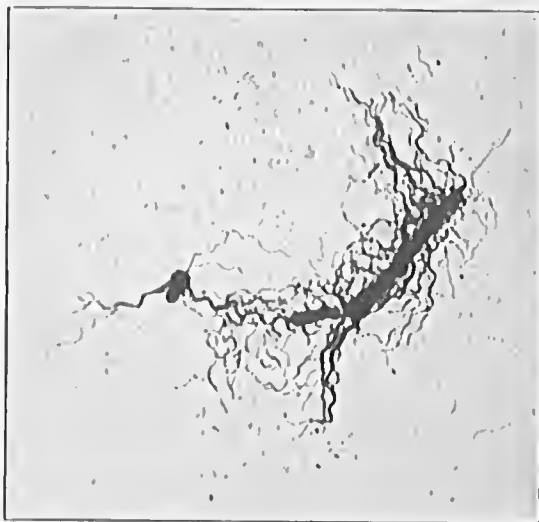


FIG. 3.—Flagella. Stained by Williams's method. $\times 2000$.

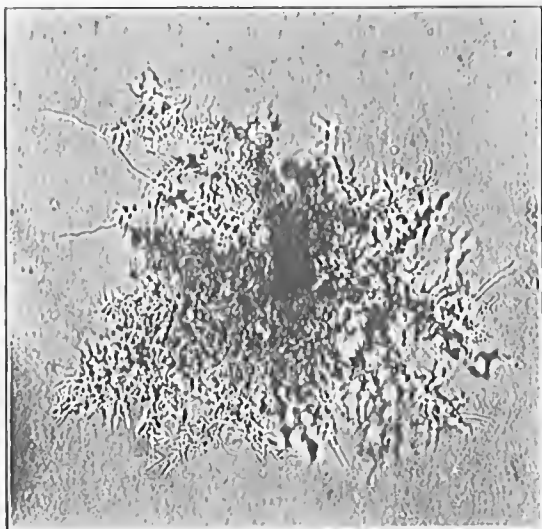


FIG. 4.—Colony in glucose agar. Low magnifying power.

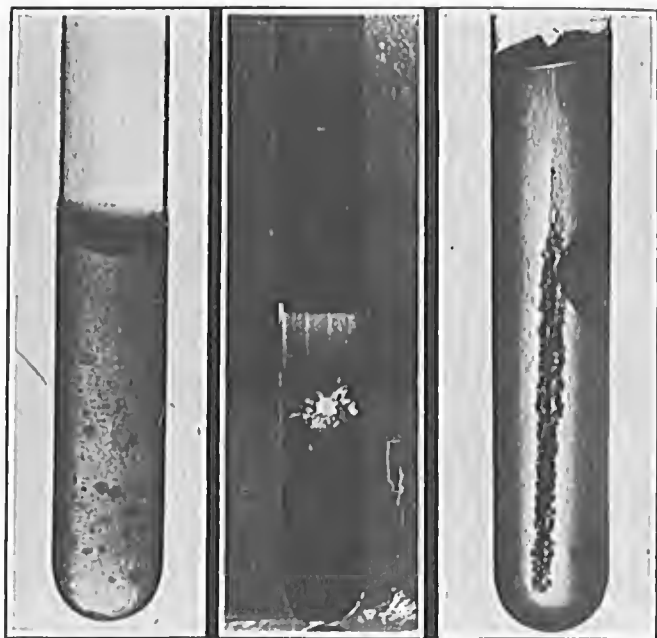


FIG. 5.—Suspension culture,
glucose agar.

Large colony in
glucose gelatin.

Stab culture,
glucose agar.

a dense mass of long and short filaments disposed in a more or less radiate manner at the periphery (Fig. 4).

In 1 per cent. glucose agar stab culture, after twenty-four hours, a grayish streak appears in the lower three-quarters of the tube along the line of inoculation, with numerous short, fuzzy, lateral outgrowths. These outgrowths increase somewhat in size, but never extend as far out into the medium as those of the tetanus bacillus. Gas forms in the medium. Spore formation is slow.

One per cent. glucose gelatin suspension cultures. The appearance of the colonies in gelatin varies in different cultures. At room temperature, after three to six days, the colonies appear as more or less globular, grayish, liquefied areas in the gelatin. At the margin of these liquefied areas filamentous outgrowths may be seen under low magnifying power radiating into the surrounding gelatin. Occasionally these filamentous processes continue to grow until they develop into long, thick projections, at the ends of which are situated new foci of liquefaction.

In 1 per cent. glucose bouillon under anaërobic conditions (Wright's method), after eighteen to twenty-four hours, the bouillon becomes turbid, and gas is constantly liberated. After twenty-four to forty-eight hours, the growth settles to the bottom of the tube as a thick, white, ropy mass. Spore formation is rapid.

On potato, rendered as nearly neutral as possible by treatment with dilute sodium hydrate solution and under anaërobic conditions by Wright's method, no growth is visible.

On coagulated blood serum, under anaërobic conditions by Wright's method, no growth is obtained.

In milk under anaërobic conditions by Wright's method, after twenty-four hours, a dark gray mass settles to the bottom of the tube. In this mass many bacilli are to be found. Forty-eight to seventy-two hours after inoculation, a marked coagulation of the milk occurs.

Pathogenesis.—The bacillus was found to kill guinea-pigs within eighteen to twenty-four hours after subcutaneous inoculation. The characteristic lesions in the guinea-pigs were: subcutaneous hæmorrhagic œdema, serous exudation in the pleural and in the peritoneal cavities, and moderate subcutaneous gas formation. The organism was found in the fluids of the sub-

cutaneous tissue, peritoneal and pleural cavities, blood and spleen.

The photomicrographs accompanying this paper were made by Mr. Louis S. Brown, of the Clinico-Pathological Laboratory of the Massachusetts General Hospital.

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